MIGRATION OF FACET FROM SIMULATION ENVIRONMENT TO DISPATCHER DECISION SUPPORT SYSTEM

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Abstract

Traffic Flow Management in the United States is a collaborative effort for dynamic and integrated handling of air traffic and airspace between the Federal Aviation Administration, Airline Operations Centers (AOCs) and other flight operator organizations. The tools and decision support systems available to manage this complex task are rapidly changing and need significant improvement. NASA has developed concepts to evaluate "what-if" situations affecting flow of traffic in the National Airspace System (NAS). These concepts are assessed using the Future ATM (Air Traffic Management) Concepts Evaluation Tool (FACET), an environment for modeling and evaluating system-wide airspace operations over the United States. A significant part of FACET has been developed to test functionalities from an airline dispatcher's perspective. This paper describes the approach taken to develop AOC requirements, assess the feasibility of implementing the requirements and ongoing efforts to transfer FACET-derived technology to users of the NAS. The advances made in the state of the art for handling of flights using integrated air traffic and weather data, along with the coupled applications of risk analysis, demand forecasting and management, and efficient route planning for various phases of flight are addressed. Although implementation issues are presented here with respect to FACET, the comments apply generally to the development of most dispatcher tools.

1. Introduction

Traffic Flow Management (TFM) is a Collaborative Decision-Making (CDM) process involving the flight operators and the Federal Aviation Administration (FAA). While the FAA (the Air Traffic Service Provider (ATSP) in the United States) is responsible for overall safety and smooth flow of traffic in the National Airspace System (NAS), the airlines and other airspace users are responsible for operating their aircraft safely and efficiently such that their schedule is maintained. The Future ATM (Air Traffic Management) Concepts Evaluation Tool (FACET) provides an environment for modeling and evaluating system-wide airspace operations over the United States [1]. There is an ongoing study at NASA Ames Research Center to understand the TFM functions performed by the Air Traffic Control Systems Command Center (ATCSCC), the Air Route Traffic Control Centers (ARTCCs) (mainly, the Traffic Management Units (TMUs) within those ARTCCs) and Airline Operations Centers (AOCs). This paper takes into account the interaction between the operations staff (Traffic Management Coordinators at ARTCCs and ATC Coordinators at AOCs) to develop requirements for a planning and assessment tool to enable more efficient NAS operations. The difference in the traffic perspective between the Air Traffic Service Provider (ATSP) and the users imposes distinct functional requirements for the development of FACET. The research effort described in this paper focuses on the use of FACET as a situational awareness and planning tool to assist AOC personnel.

Currently, the dispatchers have a number of tools available to them. Unfortunately, there are significant hurdles in extracting relevant information needed for conducting their dispatching duties. There are not many decision support tools available that integrate weather and air traffic information. The predictive information useful for flight planning, especially in the presence of congestion, is insufficient. Even though the dispatcher issues are presented with reference to FACET, the comments from the dispatch community apply to the overall development of dispatcher tools.

With this in mind, the technical approach to enhance FACET capability consisted of the following four iterative steps. It should be noted that steps (a), (b), and (c) were repeated several times over a period of two years involving dispatchers from various airlines.

(a) Elicit dispatcher roles and requirements for an improved situational awareness and integrated planning function. As a first step to fulfill this criterion, FACET was modified to work with live Aircraft Situation Display to Industry (ASDI) data [2], which is the Enhanced Traffic Management System (ETMS) data [3] without sensitive flight information, available to commercial entities. The dispatchers were trained on the use of baseline FACET software and interviews were conducted with dispatchers and ATC coordinators at several airlines.

(b) Assess the feasibility of using FACET as an improved situational awareness and integrated planning tool. The AOC personnel interviews resulted in a set of requirements, which guided further development of the FACET tool. The dispatcher comments emphasized the need for functionalities in three broad categories: (1) integration of air traffic data and weather information, (2) enhanced routing and flight scheduling capabilities and (3) flight planning with NAS congestion information.

(c) Implement modifications based on identified needs and conduct subsequent assessment. These resulted in the following: (1) understanding of operational issues (e.g. scheduling procedures) at AOCs, (2) AOC scenario testing of the FACET functionality running with recorded ASDI data, and (3) dispatcher feedback on operational issues and modifications required to address them.

(d) Identify challenges and issues in the transfer of technology to airlines and other flight operators. The comments from the AOC dispatcher assessment of modified FACET software led to live operational testing at AOCs and plans for integration of FACET with Flight Explorer, a leading provider of Aircraft Situation Displays (ASDs) to the flight operator community.

The rest of the paper is organized as follows: Sections 2 through 5 elaborate the four steps described above. Section 2 describes the airline flight planning, roles of a dispatcher and the requirements for a decision support tool (DST) to assist the dispatcher. Section 3 deals with the feasibility assessment of FACET for use as a DST. It discusses the uses of FACET as a “what-if” environment and as a real-time operational tool. Issues related to the implementation of requirements are described in Section 4. The aspects of sector load prediction, collaboration between NAS community entities, dispatcher workload, and data integration with relevant tools are also discussed in Section 4. The specific steps taken towards technology transfer to a commercial partner are presented in Section 5. The paper ends with some concluding remarks.

2. AOC Planning and Requirements of Dispatchers

AOC flight planning can be divided into strategic and tactical categories. The strategic planning is based on market demand and results in an airline schedule. Each AOC is responsible for the daily execution of the schedule. The dispatcher executes the pre-planned schedules making tactical corrections to accommodate small changes (e.g. flight plan modifications, fuel requirements based on selected route and transport load, etc.), as well as re-routing and delaying of flights in the event of major changes, such as en route constraints or airport conditions. Each airline has a differing description of the work breakdown between the Chief Dispatcher, Air Traffic Control (ATC) coordinator and an individual dispatcher.

The dispatcher is responsible for creating a flight plan that maximizes the payload an aircraft can carry safely at the lowest possible cost while maintaining the schedule. These duties also include crew availability and handling special situations (e.g. planning for de-icing of aircraft, etc.) In addition, he or she is jointly responsible with the pilot-in-command for the operational control of an aircraft according to FAA regulations [4]. Federal

Aviation Regulations (FAR) Part 121 prescribes regulations regarding the dispatch of an aircraft. The dispatcher creates a flight plan based on meteorological conditions for all phases of flight. The weather and local constraints such as the take-off slot and the availability of approach and landing facilities at the destination airport play an important role in his decision-making. The dispatcher analyzes flight times and consults with the Weight and Balance department to determine fuel requirements for the flight. Another aspect of his job is to monitor irregularities in the NAS and look for alternative airports in the event a flight needs to divert. Such irregularities affect about 10% of scheduled revenue flights annually and are largely caused by weather. Many flight plans can satisfy the airline's legal requirements, but an effective flight plan is both legal and efficient. More detailed descriptions of a dispatcher's task and their interaction with other AOC functions are available in literature [4, 5].

In order to identify dispatcher requirements for FACET, several expert elicitation sessions were held. One of them was to present FACET to the Airline Dispatchers Federation (ADF). Based on suggestions from the ADF, FACET was modified to run on a laptop with ASDI data. In this mode, FACET could predict the trajectories of the entire set of NAS flights (airborne and proposed) using either live or recorded ASDI data. A briefing describing the basic FACET capability was provided to dispatchers, followed by a demonstration on a laptop using recorded ASDI data. A series of interviews were held with senior level dispatchers from major airlines (American Airlines, Northwest Airlines, United Airlines, Delta Airlines, Continental Airlines and Southwest Airlines), regional airlines and the US Air Force, to examine the role that FACET could play at an AOC. Four-hour working sessions with 9 dispatchers from different airlines were conducted at Ohio State University and similar sessions with 5 dispatchers were held at Southwest Airlines [6]. A detailed questionnaire probing on different aspects of a dispatcher's task was used to guide the interview process. The questions used in the interview process are described in the NASA Milestone Report [7].

The dispatchers who participated were unanimously positive about the potential use of FACET for both simulation studies and as a tool for real-time use by AOCs, as illustrated by the following comments [6,8][1]:

"So FACET could come to me as a tactical air traffic coordinator for an airline, and tell me there are 10 flights going to leave Chicago in the next 30 minutes going over North Brook. Two of your flights are in those 10. One of those flights is going to take a 30-minute delay unless somebody off-loads to this other fix. Now, I'm faced with a business, and safety, decision that says do I flip the coin and risk the 30 minutes, or do I take seven minutes if I go this over way. I'll probably take the seven minutes sure delay. That kind of predictive information would be very useful."

"FACET could let me test a reroute, put that into the equation, and predict what would happen. If it could also help me identify a list of flights that are going to be impacted by some constraint, and suggest an optimized solution that affects the minimum number of flights, or affects a larger set of flights the minimum amount, that would help. It could auto-suggest not just one reroute, but several different reroute options to shortcut the dispatcher to a good solution. It would still be my place, though, to decide [whether] to move them."

"What would be useful to me would be, show me three or four routes that are valid, and that are available."

The next section describes a feasibility assessment conducted to assess FACET as a planning tool. Issues in the development of FACET software as a flight dispatch tool are discussed.

3. Feasibility Assessment of FACET

Based on expert comments from the dispatchers, there are two classes of requirements that can be fulfilled: (a) FACET can be used as an environment to provide answers to "what-if" questions relating to traffic congestion, delays and other NAS measures of performance and (b) as a real-time planning tool to assist the dispatcher in the selection of the best possible route for a flight given the various uncertainties in the system. The most important role that FACET can play is to provide dispatchers with information about predicted

[1] A selection of the verbatim comments from participants of the interview process are interspersed throughout this document in quotation marks to exemplify their views.

weather and congestion in the NAS. Given this information, and coordinating with the ATSP, dispatchers can route around congested airspace regions or modify departure times of proposed flights, so as to avoid regions of predicted congestion. Dispatchers also identified a need for evaluating congestion from an AOC point of view, especially the likelihood of a flight being delayed or re-routed. Dispatchers emphasized the development and evaluation of functionalities, which can later be integrated with the flight planning system, as opposed to proliferation of individual systems.

3.A FACET as a "What-If"' Environment

There are a number of issues of interest from an AOC perspective that could be addressed using FACET as an alternatives assessment environment. These include: visualizing and analyzing the impacts of different traffic flow management strategies, such as the use of Low Altitude Arrival and Departure Routes (LAADRs), the use of Playbook routes and the collaborative use of Coded

Departure Routes (CDRs) and evaluating the effectiveness of airline-initiated actions to deal with forecast traffic congestion or weather.

Figure 1 shows the FACET three-dimensional display with Northwest Airlines (NWA) flight histories highlighted in cyan and Southwest Airlines (SWA) flight histories in pink. These could be used for visualizing flights on specific routes with altitude profiles used for congestion management and weather avoidance.

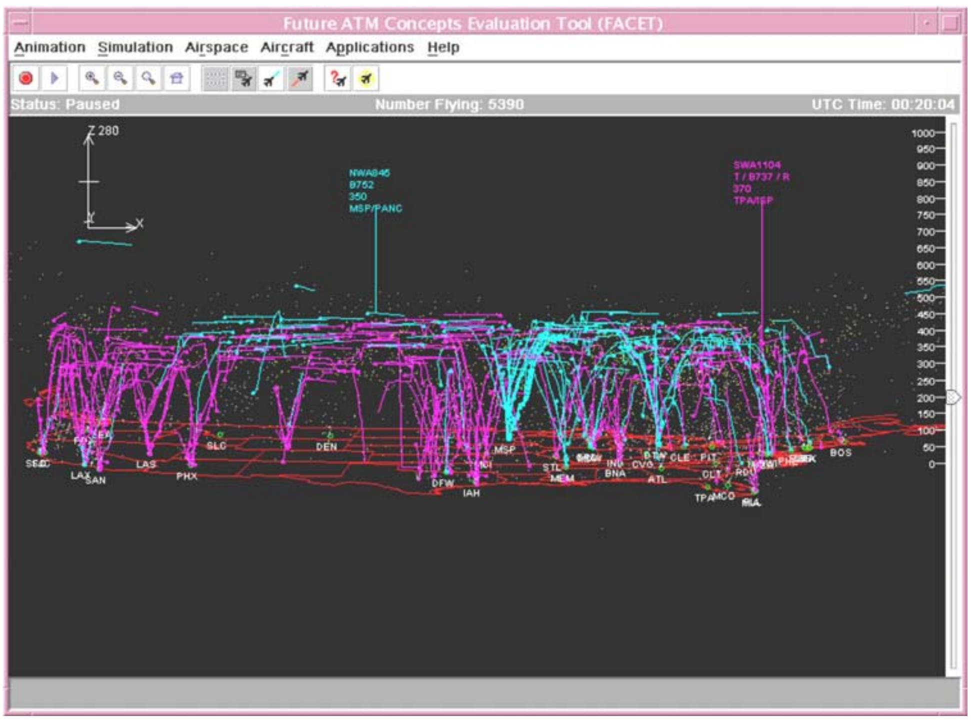

Figure 1. 3D Aircraft Display with Flight Profiles for NWA in Cyan and SWA in Pink

In order to pursue some of these questions, it was necessary to develop new capabilities or datasets within FACET, such as integration of air traffic and convective weather data, and the inclusion of a set of rules to simulate the flexible selection of alternative departure routes based on the rate of development of a weather pattern. Other proposed functions would require a tool to allow AOCs to generate a database of proposed routes in response to a weather or traffic constraint. For example:

"I would definitely want to do a research study on how much the pre-emptive actions of the user - community could solve the total pie of the air traffic problem. Use the simulator, do human-in the-loop testing with dispatchers on a variety of scenarios."

In addition to developing new capabilities to simulate scenarios of interest to AOCs, it is also important to identify appropriate measures of performance. Some of the measures for efficient flight planning with congestion information are already incorporated into FACET, such as sector loadings and the departure or airborne delays associated with particular flights. However, new metrics that look at impacts on different aggregations, such as the delays for flights filing via a particular departure fix, also need to be identified and incorporated.

3.B FACET as a Real-Time Planning Tool for AOCs

Currently, dispatchers file flight plans with insufficient knowledge of predicted NAS congestion. This can lead to any of several adverse actions by ATSP, including tactical rerouting, en route holding or delays associated with miles-in-trail (MIT) restrictions. Many AOCs have ATC Coordinator positions to deal with personnel at the FAA's Air Traffic Control System Command Center when a dispatcher has a specific question about an action taken by the ATSP on a specific flight, particular region of airspace or an airport.

At present, airline scheduling and flight planning tools function with little access to direct information or predictions about traffic bottlenecks. The modeling capabilities of FACET offer a potentially suitable approach for providing look-ahead during preflight planning and during en route re-evaluations of flight plans. Figure 2 shows FACET's Flight Monitor functionality for display of different routes for a specific flight on a desired origin-destination city-pair traversing various en route congested sectors. The nominal route filed by the dispatcher (green), the Great Circle route (pink), the Wind-Optimal route using NOAA generated Rapid Update Cycle (RUC) winds (red) and a route snapped to the Wind-Optimal route for flyability (yellow) are shown graphically on the canvas and textually at the bottom of the image. The congested sectors predicted to go over the nominal workload number of aircraft (Monitor/Alert Parameter or MAP) with all active flights (red) and some proposed flights (yellow) in those sectors are also shown. The calculations of flight planning with NAS congestion information are performed in FACET in a continuously updating mode while connected to a live aircraft data feed, like ASDI.

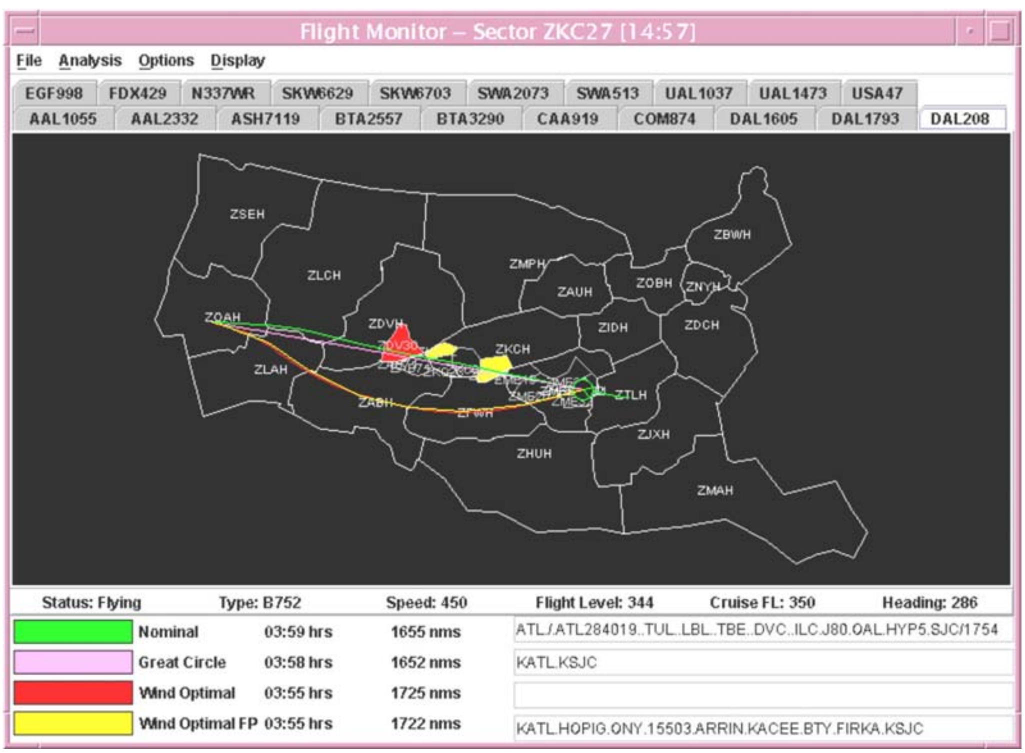

Figure 2. Flight Monitor Display in FACET

The general strategy would be to link airline flight planning tools with FACET, allowing an AOC flight planning and scheduling tool to submit proposed routings for a single flight or a collection of flights for evaluation against the current data in ETMS on filed routes. FACET could then provide feedback on predicted congestion along that route.

With these attributes, FACET was demonstrated to several participants in the Collaborative Decision-Making (CDM) community and to the 2002 En route Working Group. The latter recommended deployment of FACET as a Preemptive TFM Tool at AOCs [9].

4. Related Issues in Implementation of Requirements

This section describes issues related to the implementation of requirements from the dispatchers for development of FACET as a dispatcher tool in an operational environment. These include the need for collaboration among the service providers and users of airspace for a pre-emptive TFM, understanding of FACET predictions, associated workload for dispatchers in using a decision support system, integration of FACET with other dispatcher tools, and learning from post-operational analysis. Feedback received from dispatchers on operational issues, and the corresponding suggested modifications to software, are also discussed here.

4.A Need for Collaboration and Preemptive TFM

It is important to note that underlying the suggested use of FACET as a preemptive TFM tool in a collaborative environment is a recommendation for a paradigm shift in how air traffic is handled. A tool like FACET is of interest to AOCs because they believe that a better way to manage traffic is to tell dispatchers where the constraints are and to let them flight plan around those constraints beforehand, potentially alleviating the need for ATSP to impose a solution (e.g., ground delays, metering or reroutes) which may be less favorable. This proposed approach applies to both traffic and weather constraints:

"The airlines need to know what areas are heavy traffic areas. Then the dispatchers can easily plan around them with minor deviations."

"FACET would be great because when the Command Center says, or the ATC community says, 'these are your three options,' we could say, 'you know, you might want to consider a fourth option here that we could probably game or model on FACET.'"

"With FACET, it looks it might be possible to provide some sort of graphical representation where you could immediately see that even though 'high' or 'super high' is red, it's clear below. With that information you could then take specific flights and say, 'okay, I've got a guy that's 27 miles ahead of that sector, I can take 22,000 without a problem for another 150 miles or whatever it takes.'"

"You could also use it for negotiating times. If you already have a stream in the air coming out of the West coast to the East coast and they decide to go to a Playbook, who gets it? Is it just the guys who are in the air or is it just the guys who are on the ground?"

Based on comments like the last one and feedback from the airlines as well as participants of CDM, a functionality implemented in FACET is that of Flight Insertion in an Overhead Stream. Figure 3 shows the display for this functionality. It shows the altitudes of streams of westbound traffic (right-to-left) traveling on jet-route J70 approaching Pullman (PMM) fix. The graph shows flight level on the ordinate and time decreasing (from 16:00 UTC at left to 14:00 UTC at right) as the flight approaches PMM along the abscissa. A trial-planning function can be invoked to see if a flight could be inserted in an observed gap in the overhead stream traveling along a particular jet route. The red line shows a trial-planned climb profile to assess feasibility of inserting a flight in an observed gap, assuming a known wheels-up time.

Figure 3. Flight Insertion in Overhead Streams Functionality

When dispatchers begin utilizing predicted congestion data in their planning process, there could be significant issues regarding NAS community collaboration, which need to be addressed. This interaction needs to take place not only between different NAS users but also between NAS users and the ATSP.

Without addressing the collaboration issue, users could act independently based on predicted congestion data and simply move the congestion to another region of airspace. For example, if a convective weather cell develops in the Midwest and all NAS users independently reroute to the North of the cell, then this region of airspace becomes congested and would require intervention by the ATSP. If the necessary changes are made to FACET so that it becomes a highly distributed system, then the NAS users could use FACET to balance the traffic over the northern and southern routes, which circumvent the convective weather cell. Currently the FAA's CDM activities are addressing some of these collaboration issues, but based on the interviews, much more work remains to be done.

4.B Understanding of FACET Predictions

In order to use FACET as a "what-if" tool or as a real-time DST, the accuracy of its predictions needs to be well understood and quantified. This requires identification of an appropriate set of test scenarios and the development of a database representing the flights included in those scenarios. The most important of these issues is to improve the predictive reliability of FACET. In Research Task Order (RTO) 66 conducted at NASA Ames Research Center in conjunction with Metron Aviation, Inc. [10], many error sources associated with the en route sector demand prediction accuracy were documented. Before FACET is successfully deployed as a real-time decision support tool, many of these documented error sources should be addressed. For example, to account for departure time uncertainty in FACET's predictions, stochastic modeling capabilities are integrated into FACET [11]. Differences between FACET's predictions and those used by the ATSP also need to be understood. Without gaining a better understanding of the differences between these two sets of predictions, the ATSP and the dispatcher may come to a different conclusion on the location of congestion or the time at which it occurs. It is important to realize the AOCs and ATSP may view the impact of congestion differently. The ATSP is interested in limiting congestion from a controller's workload and safety point of view, while an AOC is likely to be more interested in analyzing whether a particular flight is likely to be rerouted or delayed, resulting in a missed schedule.

4.C Workload Issues

Similar to the workload associated with air traffic controllers due to complexity of traffic and airspace geometry [12], flight dispatchers highlighted some of the issues that affect their ability to perform specific duties. While experimenting with FACET running air traffic and weather data, the dispatchers raised numerous issues associated with incorporating predicted congestion data into their decision making process. Several dispatchers suggested adding further automation to FACET, which would rank proposed flights on the likelihood that the flight would encounter a congested region of the airspace. The dispatcher could then use the ranking to select the flight that was least likely to be rerouted or delayed by the ATSP.

In order to reduce the workload and improve the handling of data, the dispatchers expressed interest in an "alert function". This feature would automatically notify the dispatcher in case an aircraft is predicted to be impacted by NAS events, deviates significantly from the filed flight plan or the enters a holding pattern. Such modifications in the flight plan can occur when the ATSP invokes a constraint due to NAS (airport, terminal area or en route) problems. Under these circumstances a dispatcher must ensure that the flight can safely arrive at the desired destination.

Most dispatchers stated that FACET would have to be integrated with the airline's flight planning system in order to be of utmost use. This would allow the flight plan ranking and flight plan deviation detection functionality, to be seamlessly integrated into the dispatchers existing tool set. Integrating FACET with the AOC's flight planning system would also reduce workload issues associated with the introduction of a new decision support system. Most dispatchers are already suffering from use of too many specialized tools to perform their job. One dispatcher admitted to utilizing roughly 10 different applications spread over three different computer screens in order to complete his dispatching duties.

4.D Integration with Other Dispatcher Tools

There was also one caution about too naively linking airline flight scheduling tools and FACET:

"On my part, I would be careful about just thinking of plugging an airline flight planning system in for some of these folks, because the flight planning systems themselves have been de-optimized."

Integrating FACET with an AOC's flight planning system may turn out to be a challenging undertaking. Based on a questionnaire distributed during one sequence of interviews, three different airlines were using three different flight-planning systems. To become fully integrated with an AOC's operations, FACET also needs to be modified to utilize an airline's proprietary route databases, custom ascent and descent profiles of various aircraft types and the airline's weather data. With regard to this last data set, it was again found that the different airlines relied on different distributors for their weather products. For example, weather forecasts were received from National Weather Service (NWS), Weather Services International (WSI), MIT Lincoln Laboratories, in-house meteorologists, various sites on the Internet, Aircraft Communications Addressing and Reporting System (ACARS), etc.

In order to accurately predict aircraft flight trajectory profiles, FACET was already configured to read and employ RUC wind data. Due to dispatcher needs, several convective weather products, including Collaborative Convective Forecast Product (CCFP) and National Convective Weather Forecast (NCWF) from Aviation Weather Center (AWC), Corridor Integrated Weather System (CIWS) from MIT Lincoln Laboratories, and NEXRAD data from National Weather Service (NWS), are available in FACET.

Figure 4 shows the FACET graphical display with aircraft track data superimposed with the Corridor Integrated Weather System (CIWS) convective weather levels product available from MIT Lincoln Laboratories [13]. This display can be controlled to view a time evolution loop of streaming CIWS data. Based on dispatcher requirements, an additional display called Fly-By

Animation was developed in FACET, which provides a view of historical, current and predicted aircraft positions and CIWS data in a time evolution loop. With the help of this feature, a dispatcher can see where an aircraft came from along with the location of the corresponding weather. In addition, it shows how the weather is predicted to evolve and the proposed paths of aircraft, if no subsequent flight plan amendments were incurred.

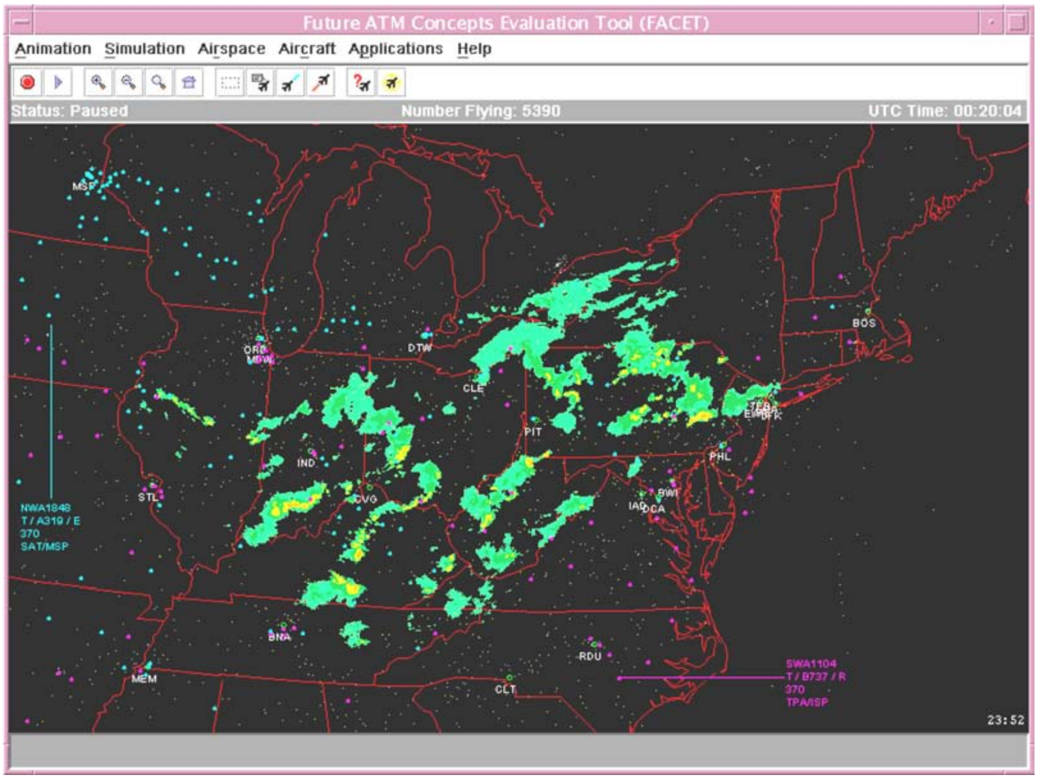

Figure 4. Display of Aircraft Positions with Superimposed CIWS Data

4.E Post-Operations Analysis

FACET has been provided to several airlines and runs in a real-time predictive mode at Northwest Airlines and Southwest Airlines.

In addition to the real-time role of FACET at those AOCs, several dispatchers also noted useful post-operations analysis roles that could be fulfilled by FACET. For example, by enhancing FACET to include a database of historical flight plan or track data, a dispatcher could examine an individual flight and determine the route flown over the last week. The dispatchers noted that in some cases, the ATSP would reroute a flight on a daily basis. If this is the case then the dispatcher could work with the

ATSP to determine how to best accommodate this situation. Another suggested use for a historic database is to probe effective sector counts as predicted by FACET and in post-operations. Thus, a user can gauge how traffic generally evolves in specific regions of airspace. Airlines are also interested in determining the cost of an ATSP-imposed flight plan amendment, which is a task that could be accomplished by FACET with simple modifications.

4.F Miscellaneous Issues

The following is a list of additional miscellaneous requirements that were suggested enhancements to FACET software:

A communications protocol or an interface specification can be defined for interactions between FACET and airline flight planning tools. An initial interface specification document has been developed for this purpose.

Stochastic models can be developed to represent the impacts of uncertainties in various parameters, specifically in weather estimation, so as to perform sensitivity analyses and complete more realistic evaluations of alternative routes using FACET.

More sophisticated metrics of airspace saturation to accurately predict system performance can be prepared. It would be beneficial for the automation to allow airline flight planning and scheduling tools to probe airspace congestion predictions from FACET in order to search for desirable routes and schedules. A route evaluator algorithm has been implemented in FACET to provide several route options based on historic data and alternate routes like wind-optimal paths, CDRs, etc.

Visual representations that allow dispatchers to view the predictions of FACET regarding airspace congestion as a function of the planned location of a flight over time would be invaluable. An application, that can help users identify regions of airspace during a predicted period of time (e.g. 2 hours), where the airline faces maximum risk due to a large number of their flights filed through or traversing that region. Figure 5 shows this Risk Assessment graph for NWA flights. It shows the number of aircraft predicted to traverse each of the sectors in decreasing order, and their predicted congestion status with respect to the Monitor/Alert Parameter (MAP). It helps to identify regions of airspace where a large number of flights for NWA are predicted to go through and their congestion level. Red and yellow indicate a violation of MAP with active and proposed flights respectively. Green indicates little or no risk.

"What-if" capabilities that allow AOC scheduling and flight planning tools to assess the aggregate impact of alternative flight plans for a group of flights could become critical. Re-evaluation algorithms in FACET could determine the need to reassess a flight plan when there is a significant change in either the performance of that particular flight (such as a delay in its departure time) or in the congestion of the airspace that it plans to traverse.

Aside from major changes discussed earlier, many smaller changes were noted that would enhance the usability of FACET by a dispatcher. Many dispatchers routinely plan routes for the same group of flights every day. To accommodate this type of activity, FACET is modified to include custom preferences and settings. Such settings control the region of airspace being monitored, size and color of airspace objects, fonts, etc. The filtering capabilities in FACET have been enhanced so that a dispatcher can monitor only a subset of an airline's entire fleet. Due to differences in dispatching tactics for short-haul and long haul flights, filters are added to FACET to distinguish between flight types. Most of these user interface issues are assessed through usability studies.

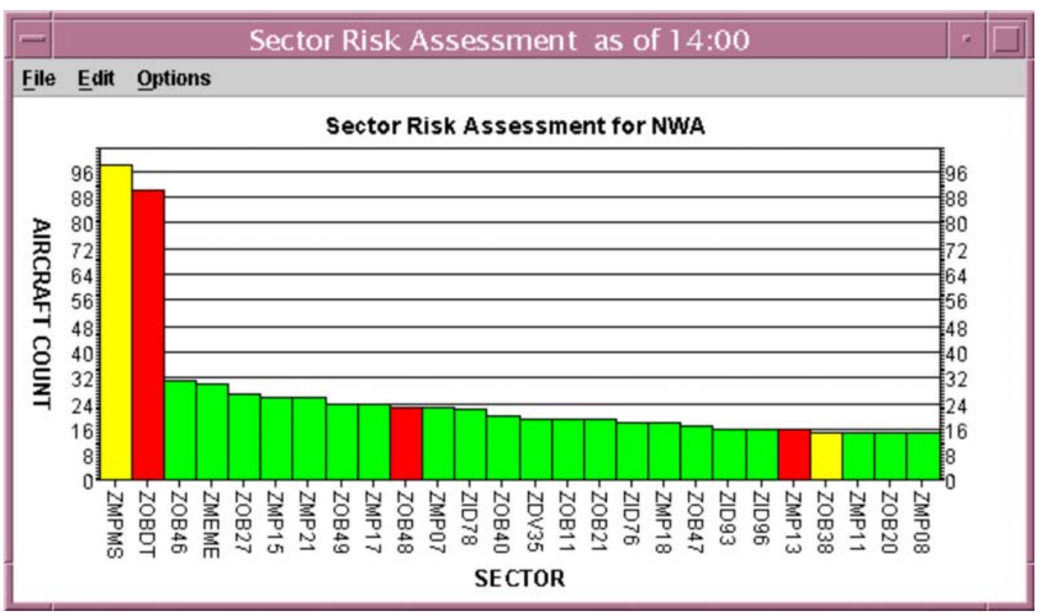

Figure 5. Sector Risk Assessment Functionality in FACET

5. Challenges of Technology Transfer: Flight Explorer Commercialization

As outlined earlier, several challenges exist for transfer of FACET technology for operational use. Some of these are listed here: technology transfer mechanism for individual AOCs (due to differing proprietary routes and varying fleet of aircraft), integrating with differing AOC flight planning systems, training of personnel, maintenance of hardware and software, and evolution of software, etc.

Due to the spectrum of implementation difficulties, it was determined that it would be best to integrate FACET with a commercial aircraft situation display (ASD) vendor. This would ensure that most valuable functionalities would be available to users of NAS, without individually integrating FACET with different flight planning systems.

According to Flight Explorer (FE), it "is the world's leading provider of flight tracking, management and information systems, specializing in real-time, Internet-based ASD systems." In order to understand the complexities of distributing FACET to the largest possible audience, NASA entered into a Space Act Agreement with FE. Under this agreement, FACET capabilities will be tested via FE under one of the following two distribution mechanisms: (1) Query Method or (2) Full Access Mode. Under the Query Method, FACET software would run at FE server sites, and users would access select FACET capabilities through the FE Graphical User Interface. In contrast, the Full Access Mode would require FACET to be deployed and updated on the client machines, similar to current mode of operations for FE software.

On May 24-25, 2004, a FE User Conference was held at the Flight Explorer Headquarters in Arlington, VA. As part of this conference, the FE-FACET integration effort was discussed. It resulted in FACET providing responses to queries stated below:

- Wind-optimized flight plan
- Impacts along flight plan (e.g. Flow Constrained Area (FCA), congestion, etc.)
- Loading of sectors projected over time
- Loading of airports projected over time
- Time and distance of aircraft to center/sector boundaries
- List of impacted aircraft

Based on the comments from the conference, there appears to be overwhelming support for the FACET/FE integration effort to proceed. Flight Explorer is currently negotiating a licensing agreement with NASA to distribute FACET functionalities.

Concluding Remarks

This paper describes the approach used in enhancing an Air Traffic Management software environment to evolve and provide decision support functionality to dispatchers and other flight planning personnel. During the course of this evolution, the roles and requirements of dispatchers at AOCs were identified and the utility of FACET for dispatchers and other AOC personnel was assessed by a combination of interviews and demonstrations. With FACET baseline software as the context, various suggestions and requirements from dispatch community are considered in an integrated manner. The AOC personnel were unanimously positive about the value of FACET as a dispatcher tool and provided both requirements and suggestions to integrate FACET into a set of user tools used by dispatchers. Independently, the 2002 En route Working Group recommended FACET as a candidate for deployment as an AOC pre-emptive TFM tool. The requirements suggested by the users varied from minor software changes to new ways of conducting business in the NAS. Pursuing some of the queries posed by flight dispatchers and understanding the spectrum of difficulties in transferring FACET technology to dispatch personnel, an integration of FACET technology with a leading ASD vendor, Flight Explorer, is underway. The two mechanisms by which this functionality will be available to users are also described. Additional requirements from dispatchers will be further refined and will guide the next phase of FACET software development.

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